

What is claimed is:

1 1. A control system for managing a production schedule
2 having time constraints that define a maximum elapsed time
3 between operations, comprising:

4 a calculation unit configured to define a plurality of
5 sub-time constraints between each two operations of
6 the production schedule, generate a plurality of
7 equations representing functions of the time
8 constraints and the sub-time constraints, and
9 calculate a value for the sub-time constraints with
10 the equations; and

11 a determination unit configured to define a status for each
12 operation according to a Work-In-Process (WIP)
13 quantity between a first operation and a checked
14 operation of the production line and a throughput rate
15 of the checked operation, check whether the status
16 violates any of the sub-time constraints between the
17 first operation and the checked operation, and release
18 a lot into the production line if the status for each

19 operation satisfies the corresponding sum of the
20 sub-time constraints.

1 2. The control system as claimed in claim 1 wherein the
2 calculation unit further simulates at least one queue time
3 between two operations, and assigns the queue time to one of the
4 sub-time constraints, thereby obtaining a remnant sub-time
5 constraint.

1 3. The control system as claimed in claim 1 wherein the
2 status is defined as follows:

3
$$S = WIP(o_1, o_n) / WPH(o_n),$$

4 wherein S is the status of a checked operation (O_n),

5 $WIP(o_1, o_n)$ is the WIP quantity between the first
6 operation (O_1) and the checked operation (O_n), and

7 $WPH(o_n)$ is the throughput rate of the checked
8 operation (O_n).

1 4. The control system as claimed in claim 1 wherein the
2 status for each operation is further defined according to a
3 process time for each operation between the first operation and

4 the checked operation except that process time attributed to the
5 first operation (O_1) and the checked operation (O_n).

1 5. The control system as claimed in claim 4 wherein the
2 status is defined as follows:

$$3 \quad S = (WIP(o_1, o_n) / WPH(o_n)) - PT(o_2, o_{n-1}),$$

4 wherein S is the status of a subsequent checked operation
5 ($o_2 \sim o_{n-1}$), $WIP(o_1, o_n)$ is the WIP quantity between
6 the first operation (O_1) and the checked operation
7 (O_n), $WPH(o_n)$ is the throughput rate of the checked
8 operation (O_n), and $PT(o_2, o_{n-1})$ is the total process
9 time of operations between the first operation (O_1)
10 and the subsequent checked operation ($o_2 \sim o_{n-1}$)
11 except that process time attributed to the first
12 operation (O_1) and the checked operation (O_n).

1 6. The control system as claimed in claim 1 wherein the
2 time constraints comprise overlapping time constraints.

1 7. The control system as claimed in claim 1 wherein the
2 time constraints comprise a constraint selected from the group

3 consisting of dual-operation, multi-operation, and continuous
4 time constraints.

1 8. The control system as claimed in claim 1 wherein a
2 production line is directed to perform related operations if the
3 lot is released to the production line.

1 9. The control system as claimed in claim 8 wherein the
2 production line is a production line for manufacturing
3 semiconductor products.

1 10. A method for managing a production schedule having
2 time constraints that define a maximum elapsed time between
3 operations, comprising the steps of:

4 defining a plurality of sub-time constraints between each
5 two operations;

6 generating plurality of equations according to the time
7 constraints and the sub-time constraints;

8 calculating the sub-time constraints using the equations;

9 defining a status for each operation according to a

10 Work-In-Process (WIP) quantity between a first

11 operation and a checked operation of the production

12 schedule and a throughput rate of the checked
13 operation;
14 checking whether the status violates the sum of the
15 calculated sub-time constraints between the first
16 operation and the checked operation; and
17 releasing a lot if the status for each operation satisfies
18 the corresponding sum of the sub-time constraints.

1 11. The method as claimed in claim 10 further comprising
2 simulating at least one queue time between two operations, and
3 assigning the queue time to one of the sub-time constraints,
4 thereby obtaining a remnant sub-time constraint.

1 12. The method as claimed in claim 10 wherein the status
2 is defined as follows:

3
$$S = WIP(o_1, o_n) / WPH(o_n),$$

4 wherein S is the status of a checked operation (O_n),
5 $WIP(o_1, o_n)$ is the WIP quantity between the first
6 operation (O_1) and the checked operation (O_n), and
7 $WPH(o_n)$ is the throughput rate of the checked
8 operation (O_n).

1 13. The method as claimed in claim 10 further comprising
2 defining the status for each operation according to a process
3 time for each operation between the first operation and the
4 checked operation except that process time attributed to the
5 first operation (O_1) and the checked operation (O_n).

1 14. The method as claimed in claim 13 wherein the status
2 is defined as follows:

3
$$S = (WIP(o_1, o_n)/WPH(o_n)) - PT(o_2, o_{n-1}),$$

4 wherein S is the status of a subsequent checked operation

5 ($o_2 \sim o_{n-1}$), $WIP(o_1, o_n)$ is the WIP quantity between

6 the first operation (O_1) and the checked operation

7 (O_n), $WPH(o_n)$ is the throughput rate of the checked

8 operation (O_n), and $PT(o_2, o_{n-1})$ is the total process

9 time of operations between the first operation (O_1)

10 and the subsequent checked operation ($o_2 \sim o_{n-1}$)

11 except that process time attributed to the first

12 operation (O_1) and the checked operation (O_n).

1 15. The method as claimed in claim 10 wherein the time
2 constraints comprise overlapping time constraints between the
3 operations.

1 16. The method as claimed in claim 10 wherein the time
2 constraints comprise a constraint selected from the group
3 consisting of dual-operation, multi-operation, and continuous
4 time constraints.

1 17. The method as claimed in claim 10 further comprising
2 performing related operations if the lot is released to a
3 production line.

1 18. The method as claimed in claim 17 wherein the
2 production line is a production line for semiconductor products.

1 19. A dispatch method that accommodates overlapping time
2 constraints that define a maximum elapsed time between select
3 operations in a production schedule, comprising the steps of:

4 defining a plurality of sub-time constraints between each
5 two operations;

6 generating plurality of equations according to the time
7 constraints and the sub-time constraints;
8 simulating at least one queue time between two operations;
9 assigning the queue time to one of the sub-time constraints;
10 and
11 calculating a remnant sub-time constraint using the
12 equations.

1 20. The dispatch method as claimed in claim 19 wherein the
2 production schedule is applied in manufacturing semiconductor
3 devices.

1 21. A method for managing the manufacture of production
2 lots of semiconductor devices, the method operable on a
3 production schedule defining a plurality of time constraints
4 between corresponding production operations, comprising the
5 steps of:

6 defining a plurality of sub-time constraints between each
7 two operations;
8 generating plurality of equations according to the time
9 constraints and the sub-time constraints;

10 calculating the sub-time constraints using the equations;
11 defining a status for each operation according to a
12 Work-In-Process (WIP) quantity between a first
13 operation and a checked operation and a throughput
14 rate of the checked operation;
15 checking whether the status violates the sum of the sub-time
16 constraints between the first operation and the
17 checked operation;
18 releasing a lot of a semiconductor product into a production
19 line when the status for each operation satisfies the
20 corresponding sum of the sub-time constraints; and
21 manufacturing the semiconductor product when the lot is
22 released to the production line.

1 22. The method as claimed in claim 21 further comprising
2 simulating at least one queue time between two operations, and
3 assigning the queue time to one of the sub-time constraints,
4 thereby obtaining a remnant sub-time constraint.

1 23. The method as claimed in claim 21 wherein the status
2 is defined as follows:

3 $S = WIP(o_1, o_n)/WPH(o_n),$

4 wherein S is the status of a checked operation (O_n),

5 $WIP(o_1, o_n)$ is the WIP quantity between the first

6 operation (O_1) and the checked operation (O_n), and

7 $WPH(o_n)$ is the throughput rate of the checked

8 operation (O_n).

1 24. The method as claimed in claim 21 further comprising
2 defining the status for each operation according to a process
3 time for each operation between the first operation and the
4 checked operation except that process time attributed to the
5 first operation (O_1) and the checked operation (O_n).

1 25. The method as claimed in claim 24 wherein the status
2 is defined as follows:

3 $S = (WIP(o_1, o_n)/WPH(o_n)) - PT(o_2, o_{n-1}),$

4 wherein S is the status of a subsequent checked operation

5 ($o_2 \sim o_{n-1}$), $WIP(o_1, o_n)$ is the WIP quantity between

6 the first operation (O_1) and the checked operation

7 (O_n), $WPH(o_n)$ is the throughput rate of the checked

8 operation (O_n), and $PT(o_2, o_{n-1})$ is the total process

9 time of operations between the first operation (O_1)
10 and the subsequent checked operation ($O_2 \sim O_{n-1}$)
11 except that process time attributed to the first
12 operation (O_1) and the checked operation (O_n).

1 26. The method as claimed in claim 21 wherein the time
2 constraints comprise overlapping time constraints between the
3 operations.

1 27. The method as claimed in claim 21 wherein the time
2 constraints comprise a constraint selected from the group
3 consisting of dual-operation, multi-operation, and continuous
4 time constraints.

1 28. The method as claimed in claim 21 wherein the step of
2 manufacturing the semiconductor product comprises performing
3 related operations thereon.

1 29. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 21.

1 30. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 22.

1 31. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 23.

1 32. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 24.

1 33. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 25.

1 34. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 26.

1 35. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 27.

1 36. A semiconductor product produced according to the
2 method for managing the manufacture of production lots of
3 semiconductor devices of claim 28.

1 37. A computer-readable medium comprising executable
2 instructions for controlling a production schedule defining a
3 plurality of time constraints between corresponding production
4 operations, comprising:

5 computer-readable program code for defining a plurality of

6 sub-time constraints between each two operations;

7 computer-readable program code for generating a plurality

8 of equations according to the time constraints and

9 the sub-time constraints;

10 computer-readable program code for calculating the

11 sub-time constraints using the equations;

12 computer-readable program code for defining a status for

13 each operation according to a Work-In-Process (WIP)

14 quantity between the first operation and the checked

15 operation of the production schedule and a throughput

16 rate of the checked operation;

17 computer-readable program code for checking whether the
18 status violates the sum of the sub-time constraints
19 between the first operation and the checked
20 operation; and
21 computer-readable program code for releasing a lot into the
22 production line if the status for each operation
23 satisfies the corresponding sum of the sub-time
24 constraints.

1 38. The computer-readable medium as claimed in claim 37
2 further comprising computer-readable program code for
3 simulating at least one queue time between two operations, and
4 assigning the queue time to one of the sub-time constraints,
5 thereby obtaining a remnant sub-time constraint.

1 39. The computer-readable medium as claimed in claim 37
2 wherein the status is defined as follows:

3
$$S = WIP(o_1, o_n) / WPH(o_n),$$

4 wherein S is the status of a checked operation (O_n),
5 $WIP(o_1, o_n)$ is the WIP quantity between the first
6 operation (O_1) and the checked operation (O_n), and

7 $WPH(o_n)$ is the throughput rate of the checked
8 operation (O_n).

1 40. The computer-readable medium as claimed in claim 37
2 further comprising computer-readable program code for defining
3 the status for each operation according to a process time for
4 each operation between the first operation and the checked
5 operation except that process time attributed to the first
6 operation (O_1) and the checked operation (O_n).

1 41. The computer-readable medium as claimed in claim 40
2 wherein the status is defined as follows:

3
$$S = (WIP(o_1, o_n)/WPH(o_n)) - PT(o_2, o_{n-1}),$$

4 wherein S is the status of a subsequent checked operation
5 ($o_2 \sim o_{n-1}$), $WIP(o_1, o_n)$ is the WIP quantity between
6 the first operation (O_1) and the checked operation
7 (O_n), $WPH(o_n)$ is the throughput rate of the checked
8 operation (O_n), and $PT(o_2, o_{n-1})$ is the total process
9 time of operations between the first operation (O_1)
10 and the subsequent checked operation ($o_2 \sim o_{n-1}$)

11 except that process time attributed to the first
12 operation (O_1) and the checked operation (O_n).

1 42. The computer-readable medium as claimed in claim 37
2 wherein the time constraints comprise overlapping time
3 constraints between the operations.

1 43. The computer-readable medium as claimed in claim 37
2 wherein the time constraints comprise a constraint selected from
3 the group consisting of dual-operation, multi-operation, and
4 continuous time constraints.

1 44. The computer-readable medium as claimed in claim 37
2 wherein the production line is a production line for
3 semiconductor products.

1 45. A computer-readable medium for dispatching product
2 lots in a in a production process having a plurality of
3 overlapping time constraints between corresponding production
4 operations, comprising:

5 computer-readable program code for defining a plurality of
6 sub-time constraints between each two operations;

7 computer-readable program code for generating plurality of
8 equations according to the time constraints and the
9 sub-time constraints;
10 computer-readable program code for simulating at least one
11 queue time between two operations;
12 computer-readable program code for assigning the queue time
13 to one of the sub-time constraints; and
14 computer-readable program code for calculating a remnant
15 sub-time constraint using the equations.

1 46. The computer-readable medium as claimed in claim 45
2 wherein the production process is a production process for
3 manufacturing semiconductor products.